DISTRICT SALES OFFICES

See your Insulator Department representative for complete technical information on Anti-Contaminants, or write directly to: Insulator Department, General Electric Company, South Charles and Cromwell Streets, Baltimore 30, Maryland.

ATLANTA 2, Georgia
P. O. Box 4927

BALTIMORE 30, Maryland
South Charles and Cromwell Streets

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1824 29th Avenue, South
Room 222

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DENVER 11, Colorado
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478 Northwest Highway

LOS ANGELES 14, California
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Suite 2204

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7 Cottage Street

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INSULATOR DEPARTMENT
GENERAL ELECTRIC
BALTIMORE, MARYLAND

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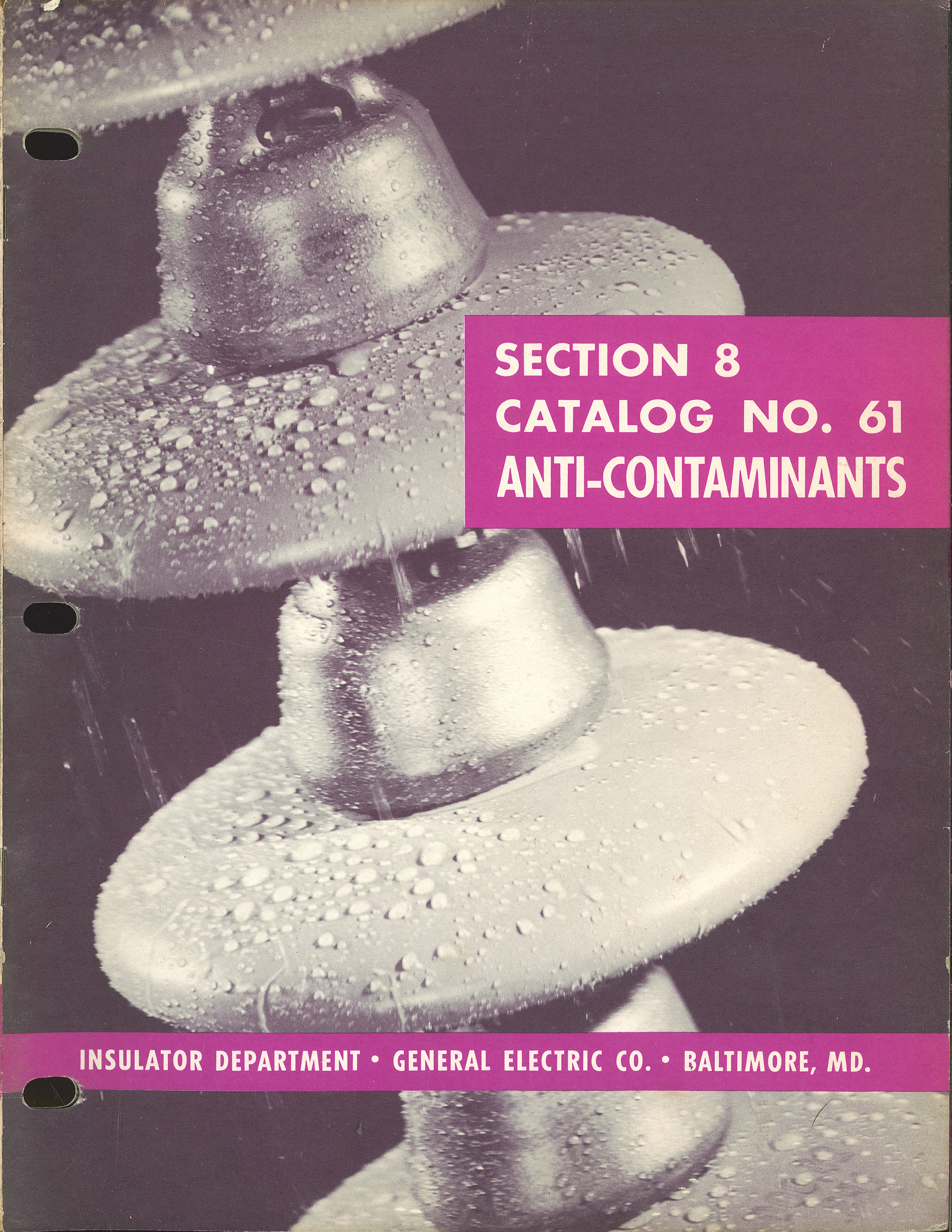
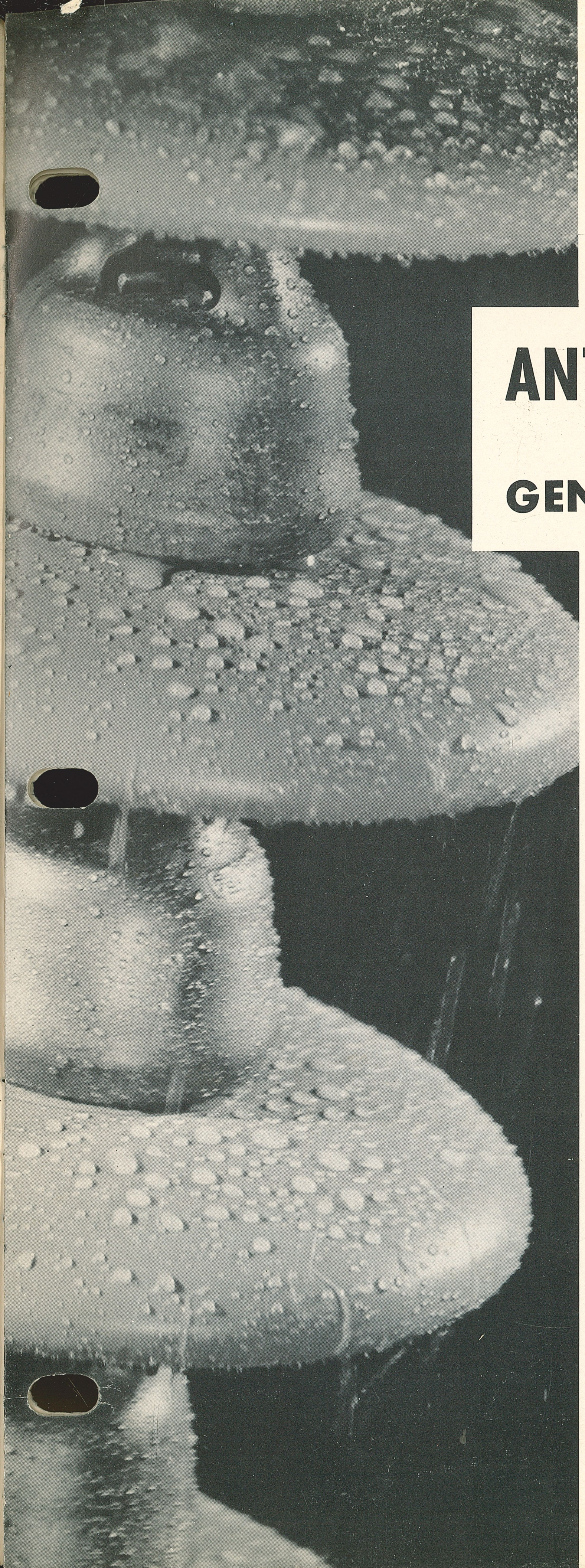


SECTION 8
CATALOG NO. 61
ANTI-CONTAMINANTS

INSULATOR DEPARTMENT • GENERAL ELECTRIC CO. • BALTIMORE, MD.



ANTI-CONTAMINANTS

GENERAL INFORMATION

For many years, one of the chief unresolved operating problems of electric utilities in the United States has been atmospheric contamination and its effects on continuity of operation of power lines. These contaminants can be divided roughly into two general categories: (1) industrial contaminants emanating from chemical plants, cement mills, steel plants, metallurgical plants and similar installations, and (2) salt contamination encountered in coastal areas. Moreover, contamination problems become more acute as industrialization of our economy continues, as increasing miles of line are erected by utilities, and as population densities increase in coastal areas. Despite the importance of the problem, and the very substantial efforts directed in this area over a long period of time, there is still no known general solution.

However, as a result of intensive effort by operating utilities and cooperating manufacturers, on proper line design and subsequent operational maintenance, satisfactory operation can be maintained in most localities at reasonable cost by using one or more of the following approaches:

1. Over-insulation of the line or station (and/or special insulator units).
2. Periodic cleaning of the insulators (by washing or other means).
3. The application of special insulator coatings.

ANTI-CONTAMINANTS

GENERAL INFORMATION

A CLOSER LOOK AT SOME OF THE PROBLEMS

The presence of conducting films on the surface of outdoor insulators resulting from atmospheric contamination leads to a number of serious operating conditions. These may be briefly summarized as follows:

EXCESSIVE LEAKAGE CURRENT

Most contaminants with which utility companies must contend are relatively innocuous under dry conditions. However, in the presence of moisture, electrolytes leach out of the contaminating coating, forming a conducting film across the insulator and frequently resulting in serious leakage currents across the insulator. This can lead to localized sparking around the insulator unit and, under prolonged conditions, can cause cross arm and pole top fires.

FLASHOVERS

Under highly stressed conditions resulting from severe surface contamination on insulators local sparking occurs, distorting the gradient over the surface of the insulators. Stress concentrations at the extremities of the insulators tend to promote growth of the spark. If several such sparks occur simultaneously on the same insulator, there is hazard of flashover and loss of service.

PUNCTURE

The local sparking which occurs over the surface of dirty insulators results in considerable surface heating. If the combination of local voltage gradients and local temperature rise is sufficient, there is danger of puncture of the insulator. Under such conditions, puncture may be caused either by thermal cracks set up by intense local heating and differential heating, or by the increase in the temperature of the dielectric material itself above its safe operating point. As the temperature rises, the resistance of most insulating materials rapidly diminishes. This results in more energy dissipation and more heating until ultimate breakdown occurs.

CORROSION

As a result of operation in dirty areas, greatly accelerated corrosion of metallic parts immediately adjacent to the insulators has been observed. Corrosion may be occasioned by any of several actions. Some of these are described below.

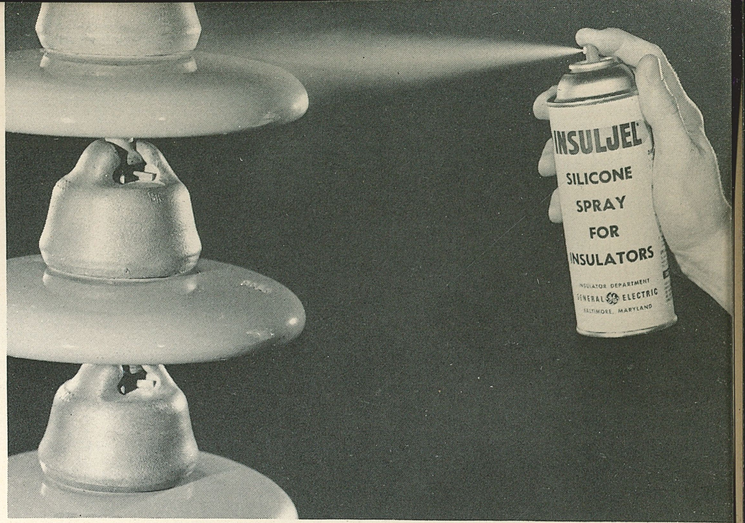
a. Leakage currents flowing through conducting films may exhibit directional properties so that some electrolytic effects may be observed at the terminal electrodes.

b. Where violent corona or local arcing occurs, the formation of ozone and nitric acid may accelerate corrosion on the metal immediately adjacent to the insulator.

c. Where localized sparking occurs over a long period of time and terminates on one of the metallic electrodes, galvanizing at the surface may be damaged or destroyed due to the burning effect of the arcs themselves. The base metal is then exposed to the normal corrosive action of the atmosphere.

The seriousness of these problems from the standpoint of an operating utility will generally be governed by—

1. The density or rate of the dirt deposit.
2. The frequency and intensity of natural washing rain and wind.
3. The nature of the dirt—its conductivity and its inclination to adhere to insulator surfaces.



INSULJEL quickly, easily protects insulator surfaces.

SOME SOLUTIONS

We indicated earlier that the solutions to the problems of atmospheric contamination fell generally into three categories, namely—over-insulation, periodic washing, and the application of special insulator coatings.

OVER-INSULATION

The degree of over-insulation which may be required to substantially improve operating characteristics in a contaminated area must be determined for each individual case. This, of course, is dependent upon the type of contaminant present and the density of the contaminant in the atmosphere. It can be said, however, that very substantial increases in leakage distances are required to result in any recognizable improvement in performance. Increases in the order of 50% or more over normal recommended leakage distances should be considered. The more severe the problem, in most instances, the more drastic the increase in leakage distance.

CLEANING

Periodic cleaning of insulators is helpful in reducing outages from atmospheric contamination causes. Probably the most common method of insulator cleaning is accomplished by high pressure washing with water. In most instances, this is accomplished with the line remaining in operation thus causing no interruption of service. Generally speaking this method is effective where the materials constituting the contamination are either highly soluble such as salt from ocean spray and certain chemical contaminants, or are virtually insoluble and lodge on insulator surfaces with little or moderate tendency to adhere.

The very severe conditions occur when the contaminant is a material which hardens and bakes on to the insulator surfaces, thus making a semi-conducting coating which is tightly adherent and extremely difficult to remove by washing or by mechanical processes. Cement dust in combination with moisture encountered around cement mills is a typical example. Where extremely severe coatings of this nature are present, it is generally most effective to replace the insulators with clean units, then clean the contaminated units on the ground with special methods.

Some materials can be removed by mechanical means using abrasive materials, (such as INSULBRITE* page 9) steel wool, wire brushes or some combination of these.

Where very heavy coatings are to be removed, the most satisfactory means is to attack the coating with muriatic acids. They can be applied by painting the contaminated surface with the acid, repeating the operation until the coating disintegrates and can be removed from the surface. Caution—with this method, great care must be taken to keep the acid from the cement joints in the insulator units and off the galvanized metal parts.

COATINGS

Another effective weapon in dealing with the contamination problem is the use of insulator coating agents—materials which have been developed in the relatively recent past.

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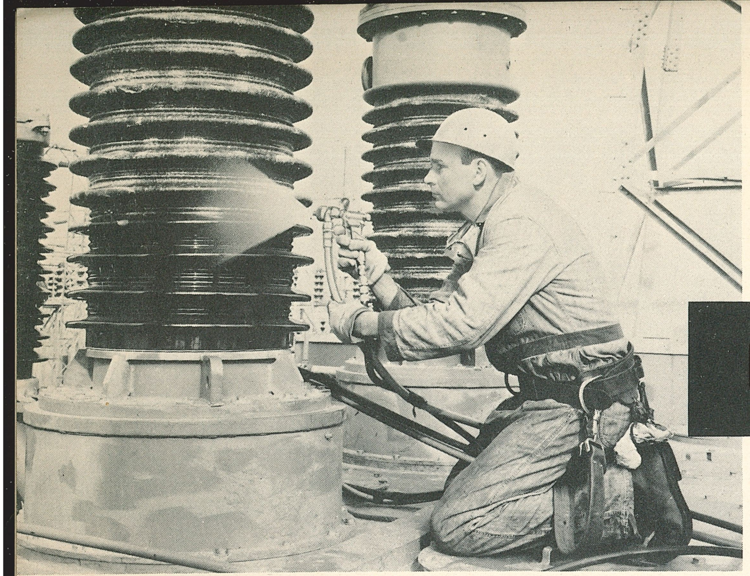
* Registered trademark of the General Electric Co.

ANTI-CONTAMINANTS

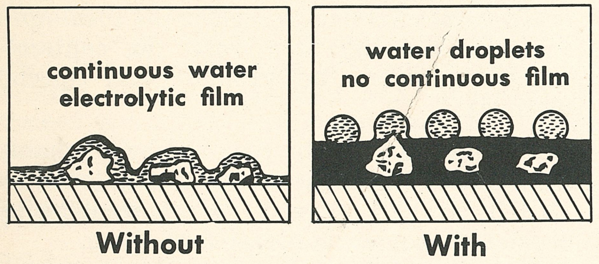
INSULGREASE



Locke* insulator getting INSULGREASE protection. (Photo courtesy of the Power Authority of the State of New York).

INSULGREASE* is a silicone grease that has been designed to improve insulator electrical wet characteristics through its water shedding and amoebic action.

WATER REPELLENT ACTION OF INSULGREASE

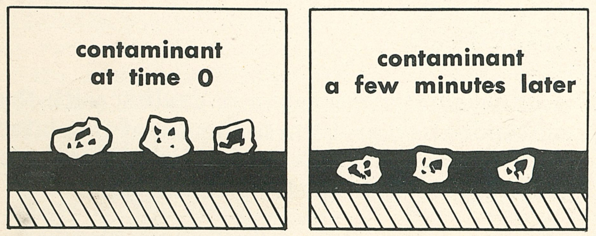

continuous water electrolytic film
water droplets no continuous film

Without

With

Applied to insulator surfaces, INSULGREASE leaves a protective grease coating. Moisture "bunches" into separate droplets. These droplets, in contact with any of the soluble contaminants, are restricted from forming a continuous electrolytic film on the insulator surface. Low resistance paths are broken up, hampering the formation of excessively distorted voltage gradients across the insulator.

AMOEBIC ACTION OF INSULGREASE



Particles deposited on the grease surface are engulfed by amoebic action. Each particle is permanently sealed against contact with moisture. This prevents the soluble contaminants from becoming electrolytes, and restricts their contributing to low electrical characteristics during periods of rain, dew or fog.

INSULGREASE ADVANTAGES

- INSULGREASE coated insulators demonstrate improved electrical performance during conditions of rain, dew or fog.
- INSULGREASE can be reapplied one coating over another. This eliminates the necessity of cleaning insulators before each application. Cleaning when desired is quick and easy, with most high dielectric petroleum base solvents.
- INSULGREASE prevents contaminants from adhering tightly to insulator surfaces making cleaning easy.
- INSULGREASE, in addition to combating insulator contamination, is an excellent lubricant for switches, disconnects and other electrical equipment. INSULGREASE lubricates operating mechanisms, restricts metallic corrosion, provides smooth, non-stick operation at below —40°F.

FAST, EASY APPLICATION

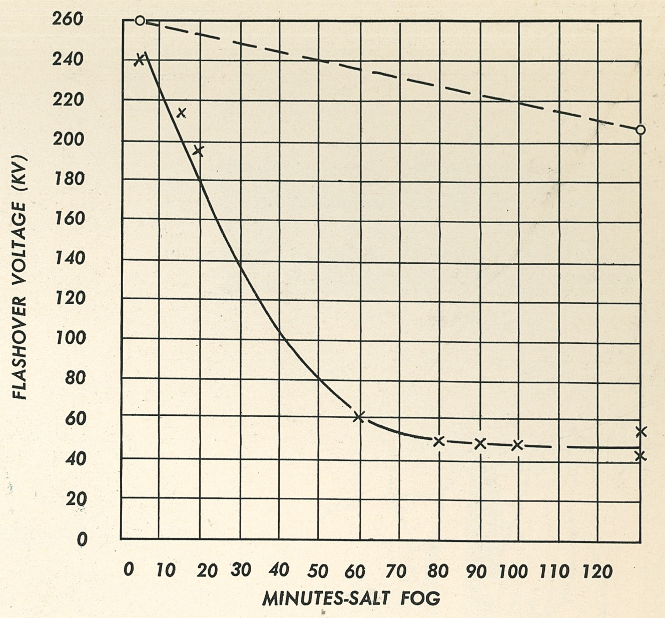
INSULGREASE has been applied by using hand brushes. Some utilities have developed their own equipment using a pressure fed brush on the end of a hot stick for use in applying INSULGREASE to energized lines. For larger installations (such as entire substations) INSULGREASE can be sprayed with equipment similar to that used in undercoating automobiles. For information on application methods, contact your Insulator Department representative.

* Registered trademark of the General Electric Co.

SALT FOG CONTAMINATION TESTS

Contamination (salt fog) tests on 69 KV cap and pin insulators cat. #29511

x Plain insulators
o Insulators with INSULGREASE



HEAVY PORTLAND CEMENT CONTAMINATION

10.00,000

A laboratory test was made by contaminating two 10″ suspensions with a heavy layer of Portland cement. One of the units was coated with INSULGREASE, while the other was left untreated. The untreated unit flashed over at 26 KV while the sprayed unit averaged 52.1 KV.

Sample	Condition	W.F.O. Test Result†
A	Heavy layer of cement	26.0 KV
B	Heavy layer of cement with INSULGREASE applied over the contaminant	52.1 KV

†Average of 5 Flashovers   Standard W.F.O. Test

TYPICAL PROPERTIES OF INSULGREASE

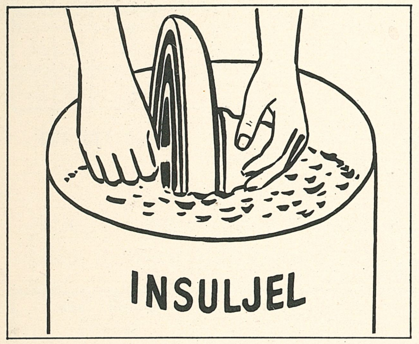
Color	colorless, translucent	Dielectric strength, volts/mil, @ 10 mils	750
		Dielectric constant, 48 hrs., 23°C, 50% RH*	
Penetration (ASTM D217-527-J) unworked @ 25°C	180-240	@ 60 cycles	3.10
worked @ 25°C (60 cycles)	less than 310	@ 10^5 cycles	3.10
		Condition, 96 hrs., 23°C, 96% RH	
Bleed, percent, 24 hrs. @ 150°C	less than 8	@ 60 cycles	3.10
		@ 10^5 cycles	3.10
Evaporation, percent, 24 hrs. @ 150°C	less than 2	Power factor, 48 hrs., 23°C, 50% RH	
		@ 60 cycles	.0050
		@ 10^5 cycles	.0025
Solubility, percent (loss in wt., 7 days @ 25°C)	less than 1	Condition, 96 hrs., 23°C, 96% RH	
		@ 60 cycles	.015
Flow point (vertical surface 4 hrs. @ 160°F)	0	@ 10^5 cycles	.0025
Specific gravity 25°C	1.026	Arc resistance, seconds (ASTM D495-48T) - Min.	125

* RH—Relative humidity

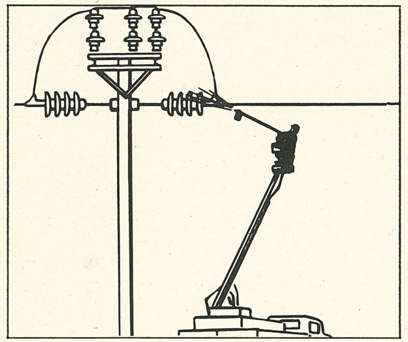
ANTI-CONTAMINANTS

INSULJEL

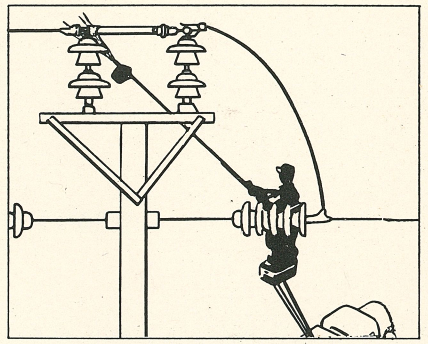
FAST, EASY APPLICATION



Hand Dipping



Hot Line Spraying



Lubricating Electrical Equipment

INSULJEL* is a handy liquid form of INSULGREASE. It is a silicone grease dispersed in a quickly evaporating vehicle. Upon evaporation of the vehicle, a layer of pure INSULGREASE is left on the surface sprayed.

APPLICATION INFORMATION

The coating to be used depends upon the contamination encountered. Coatings used vary from 15-100 mils, the thicker coatings for more severe contamination. INSULJEL is recommended for applying thin coatings since it is difficult to apply the INSULGREASE uniformly thin. It is recommended that the user determine the frequency of application by a test installation in the troubled spot. One procedure now being used to determine the optimum time to recoat is as follows:

1. Coat test units and leave for one month.
2. Clean off grease and reapply a new coating.
3. Leave the second coating on two months.
4. Repeat cleaning and coating while extending the length of time between coats until the maximum life expectancy is approached (by observation or leakage measurements).
5. Apply a margin of safety and set up the maintenance program for recoating.

The table on page 7 will help in estimating the grease required.

ORDERING INFORMATION

INSULGREASE is available in 1 gallon (8 pounds), 5 gallon (40 pounds) and 50 gallon containers (415 pounds).

INSULJEL is available in 16 oz. aerosol spray can, 1, 5 and 50 gallon containers.

Prices are included in our general price list.

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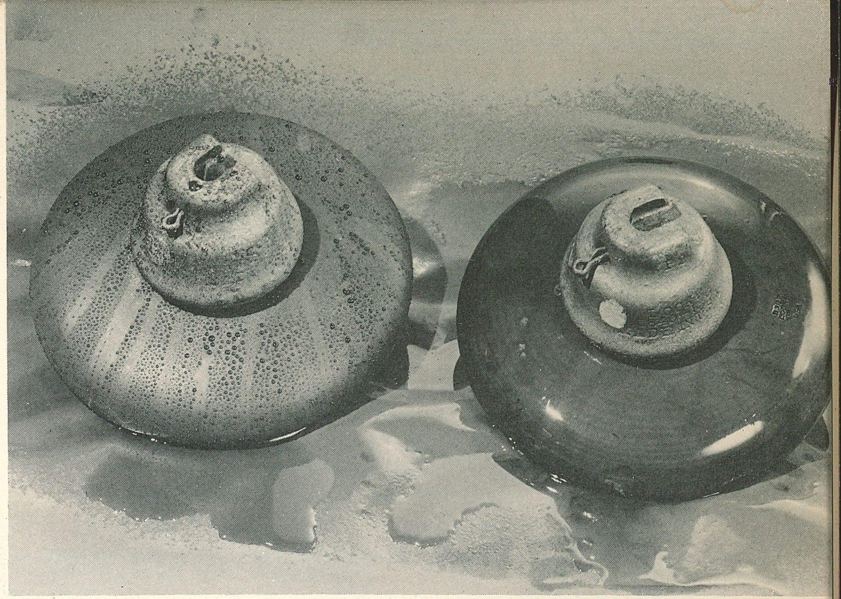
* Registered trademark of the General Electric Co.



Insulator at left was sprayed with INSULJEL (see page 6), then both insulators were sprayed with water.

LOCKE Catalog No.	Surface Area Sq. In.	10 Mil Coating on 100 Units Requires:	
		Gallons of INSULGREASE	Gallons of INSULJEL
Suspension Insulators			
16583 (6″ x 5½″)	80	0.38	1.11
1840 (10″ x 5¾″)	224	1.05	3.10
18134 (10″ x 6½″ Fog)	346	1.61	4.76
Multipart Pin Types			
1027	193	0.90	2.66
1035	274	1.28	3.76
1044	406	1.89	5.57
Switch Insulators (Cap and Pin)			
29200	104	0.49	1.44
29250	191	0.89	2.62
29251	385	1.80	5.31
29455	613	2.86	8.45
29153	916	4.28	12.62
29511	678	3.16	9.34
7785	1088	5.08	14.98
23333	1088	5.08	14.98
23082	1258	5.86	17.31
23083	1258	5.86	17.31
Station Posts			
29007	152.9	0.75	2.14
29015	235.12	1.13	3.30
29023	289.9	1.40	4.05
29034	660.32	3.17	9.25
29046	861.63	4.14	12.06
29069	1000.2	4.8	14.00

ANTI-CONTAMINANTS

INSULCONE

INSULCONE* is a silicone base insulator treating fluid intended to retard the effects of some types of contamination. It is applied to the insulator surface by brushing, dipping or spraying. Its capillary action hinders the spreading of dissolved materials.

INSULCONE tends to "bunch" the moisture in droplets, retarding the formation of a continuous electrolytic film. The continuous low resistance paths are broken up to various degrees hampering the flow of leakage current and the formation of excessively distorted voltage gradients. It also has the ability to deter the deposit of contaminants by retarding their bonding action. INSULCONE treated insulators are more easily cleaned than untreated insulators.

Tests and investigations indicate that Insulcone should provide:

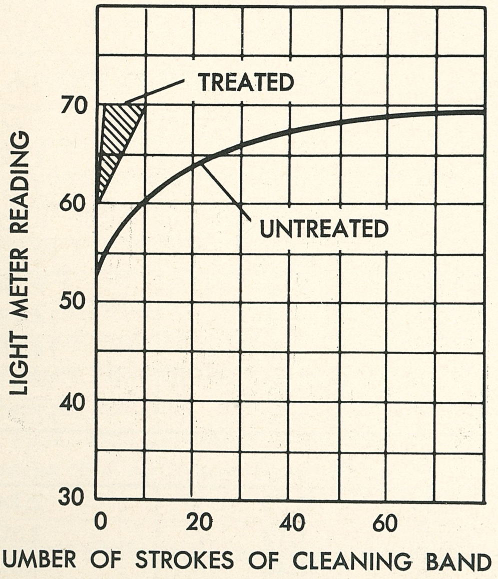
1. Higher foul weather flashover values.
2. Decreasing leakage currents, with resulting decreases in pole top fires, pin burning, radio interference and hardware corrosion.
3. Longer time between periods when insulators operating under conditions of severe contamination must be cleaned.
4. Easier cleaning because of reduced bonding action between contaminant and the insulator surface. (See chart below.)

. . . all resulting in better service, improved performance, less frequent changes and lower maintenance costs.

ORDERING INFORMATION

INSULCONE is available in 1 gallon, 5 gallon and 55 gallon containers. Prices are included in our general price list. Complete information is available from your Insulator Department representative.

RELATIVE EASE OF CLEANING SILICONE TREATED AND UNTREATED INSULATORS



A special test fixture was constructed to measure light readings from insulator surfaces and to control pressure and stroke of a cleaning cloth. The light meter was adjusted to give a full scale reading on a new insulator. The results of one such test, using insulators exposed for eight months in an industrial plant atmosphere, are shown in the accompanying chart. Ten strokes of the cloth on the silicone treated unit produced results unattainable after eighty strokes on a similarly contaminant coated but untreated unit.

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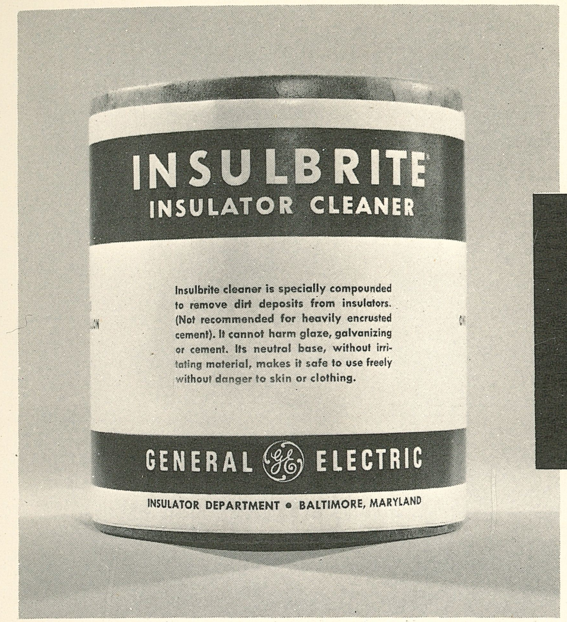
INSULBRITE
INSULATOR CLEANER
Insulbrite cleaner is specially compounded to remove dirt deposits from insulators. (Not recommended for heavily encrusted cement). It cannot harm glaze, galvanizing or cement. Its neutral base, without irritating material, makes it safe to use freely without danger to skin or clothing.
GENERAL ELECTRIC
INSULATOR DEPARTMENT • BALTIMORE, MARYLAND

INSULBRITE INSULATOR CLEANER

INSULBRITE* is a specially compounded powder-type cleaner which quickly removes from insulators all types of dirt deposits, except heavily encrusted cement. It works rapidly and easily, and cannot harm glaze, galvanizing or cement. It has a neutral base and contains no irritating material, making it safe to use freely, without danger to skin or clothing.

APPLICATION

Insulbrite is used in the same way as other powder cleaners.

It does not matter how serious the dirt condition is. Even contamination on old insulators used in tunnels or combined steam and electric railroads yields readily.

In cases where the operating and atmospheric conditions were so severe that the glaze actually became pitted, Insulbrite removed all signs of contamination and left the remaining glaze as bright and clean as on the day the insulators left the factory.

DIRECTIONS FOR USE

1. Apply Insulbrite insulator cleaner to coarse, damp cloth. Rub insulator until dirt is removed.
2. Let dry. Polish with clean, coarse cloth or rinse with water and wipe dry.
3. Repeat, if necessary, to restore glaze lustre

ORDERING INFORMATION

INSULBRITE is available in half gallon containers. Prices are included in general price list.

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* Registered trademark of the General Electric Co.